Performance of fast radiative transfer models in the microwave spectrum

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CISESS Science Team Meeting, University of Maryland

November 12, 2019

- Comparing CRTM and RTTOV using similar atmospheric and surface dataset (Era-5)
- Comparing CRTM and RTTOV vs. observations from ATMS onboard NPP and N20
- Comparing CRTM and RTTOV vs. observations from GPM-GMI
- Performance of fast models (CRTM & RTTOV) vs. a LBL model
- Using GRUAN observations to (may be) validate satellite observations

Collocation Technique

Era-5 Resolution: 0.3 deg and 3 hour Collocations criteria: 30 km and 60 minutes



MW Spectrum and ATMS Channels

Chan 1: 23.8 GHz, Chan 10: 55.5, Chan 15: 57.290344 $\pm 0.3222 \pm 0.0045$ Chan 22: 183.31 ± 1



ATMS-N20 Biases vs. different RTMs



ATMS-NPP Biases vs. different RTMs



GMI-GPM Biases vs. different RTMs



ATMS-N20 RMSEs for different RTMs



Difference between RTMs for ATMS-N20



Top Left: Channel 1, Top Right: Channel 12, Bottom Left: Channel 16, Bottom Right: Channel 22

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Impact of WV spectroscopy



Impact of SRF



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Impact of emissivity



FOV Impact



Top: Channel 1, Bottom: Channel 16

Double difference: [RT – NPP] – [RT – N20]



Double difference: [RT – NPP] – [RT – N20]



Double difference: [RT – NPP] – [RT – N20]



STATISTICS FOR RADIANCES FROM NPP/ATMS CHANNEL =20, ALL DATA [TIME STEP = 6 HOURS] Area: lon_w= 0.0, lon_e= 360.0, lat_s= -90.0, lat_n= 90.0 (over All_surfaces) EXP = 0001 (LAST TIME WINDOW: 2019111103)



STATISTICS FOR RADIANCES FROM NOAA-20/ATMS CHANNEL =20, ALL DATA [TIME STEP = 6 HOURS] Area: lon_w= 0.0, lon_e= 360.0, lat_s= -90.0, lat_n= 90.0 (over All_surfaces) EXP = 0001 (LAST TIME WINDOW: 2019111103)



STATISTICS FOR RADIANCES FROM NOAA-20/ATMS CHANNEL =22, ALL DATA [TIME STEP = 6 HOURS] Area: lon_w= 0.0, lon_e= 360.0, lat_s= -90.0, lat_n= 90.0 (over All_surfaces) EXP = 0001 (LAST TIME WINDOW: 2019111103)



STATISTICS FOR RADIANCES FROM NPP/ATMS CHANNEL =10, ALL DATA [TIME STEP = 6 HOURS] Area: lon_w= 0.0, lon_e= 360.0, lat_s= -90.0, lat_n= 90.0 (over All_surfaces) EXP = 0001 (LAST TIME WINDOW: 2019111103)



Conclusions

- CRTM version 2.3 is slightly improved compared to V2.1 for the window channels but the sounding channels remain the same given no change in transmittance coefficients
- The difference between RTTOV and CRTM simulations for most ATMS temperature sounding channels is very small, but the differences are larger for the water vapor and window channels
- ATMS N20 measurements better agree with Era-5 reanalysis before reprocessing ATMS/NPP observations
- The LBL simulations using different WV spectroscopies show a large impact of spectroscopy on both WV and Window channels
- ATMS/NPP observations, especially for WV channels, are greatly improved after recent reprocessing (confirmed both in this study and also from ECMWF omf statistics)

Thank you for your attention!